Earth Observing System Microwave Limb Sounder (EOS MLS) Science Data Processing

February 26-28, 2002

Science Data Processing Workshop 2002

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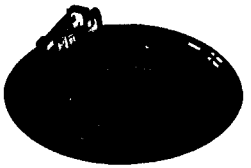

Mission Background

- EOS MLS is an atmospheric remote sensing experiment led by Jet Propulsion Laboratory of the California Institute of Technology with scientific collaboration from the University of Edinburgh Meteorology Department.
- EOS MLS is a passive instrument that observes natural thermal radiation from the limb of Earth's atmosphere and yields the concentration of chemical species and atmospheric parameters.
- EOS MLS will be operational on NASA's EOS Aura spacecraft from 2003 to 2009.
- EOS MLS is a follow-on to the very successful MLS on NASA's Upper Atmospheric Research Satellite (UARS) – 1991 launch.
- EOS MLS objectives are to learn about:
  - Stratospheric chemistry and causes of ozone changes
  - Processes affecting climate variability
  - Pollution in the upper atmosphere

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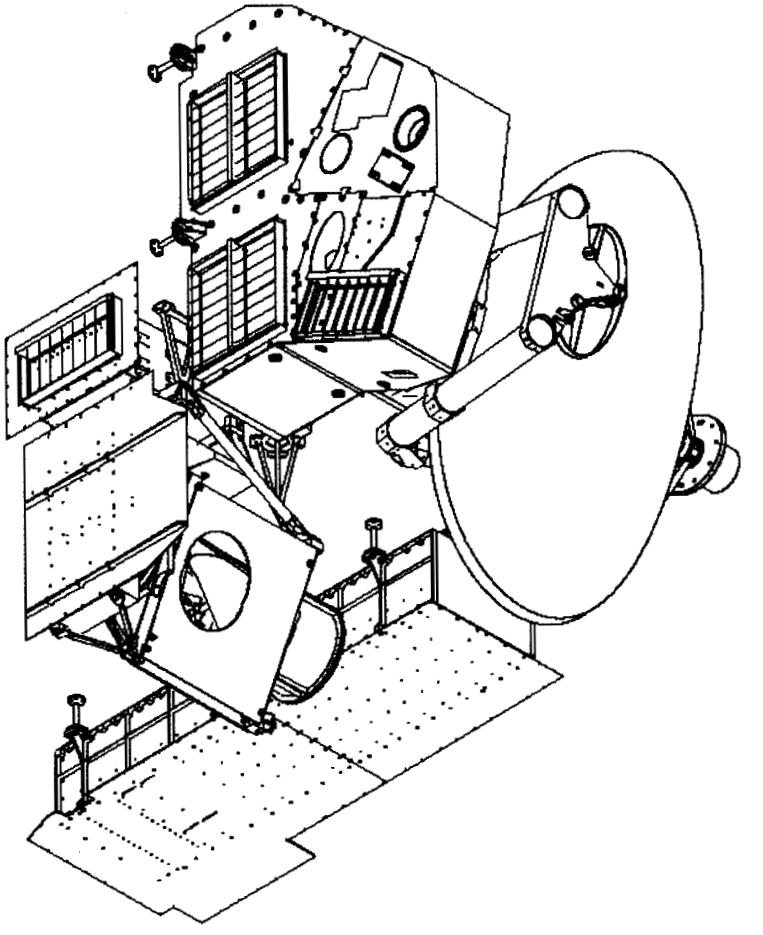
Instrument Specifications

- **Makes passive measurements in broad bands at 5 frequencies:**
  - **118 GHz for temperature and pressure**
  - **190 GHz primarily for H_2O and NHO_3**
  - **240 GHz primarily for O_3 and CO**
  - **640 GHz primarily for HCl, ClO, N_2O, BrO, HO_2, and HOCl**
  - **2.5 THz for OH**
- **450 Kg mass**
- **550 Watts power consumption**
- **100 kb/s data rate**



Science Data Software Components

- **MLS Science Investigator-led Processing System (SIPS):**
  - Processes the science data for the entire mission.
  - Delivers standard data products to MLS SCF and GSFC DAAC.
  - Implemented and operated by Raytheon ITSS of Pasadena.
- **MLS Science Computing Facility (SCF):**
  - Develops and tests the science processing software.
  - Determines the quality of data products.
  - Validates the scientific data sets.
  - Performs scientific analyses of the data.
  - Implemented and operated by MLS Science Team at JPL.
- **GSFC Earth Science Distributed Active Archive Center (GES-DAAC)**
  - Provides Level 0 and ancillary data to MLS SIPS.
  - Provides long term archive for standard science data products.
  - Provides distribution for standard science data products to users.
  - Provides user support.

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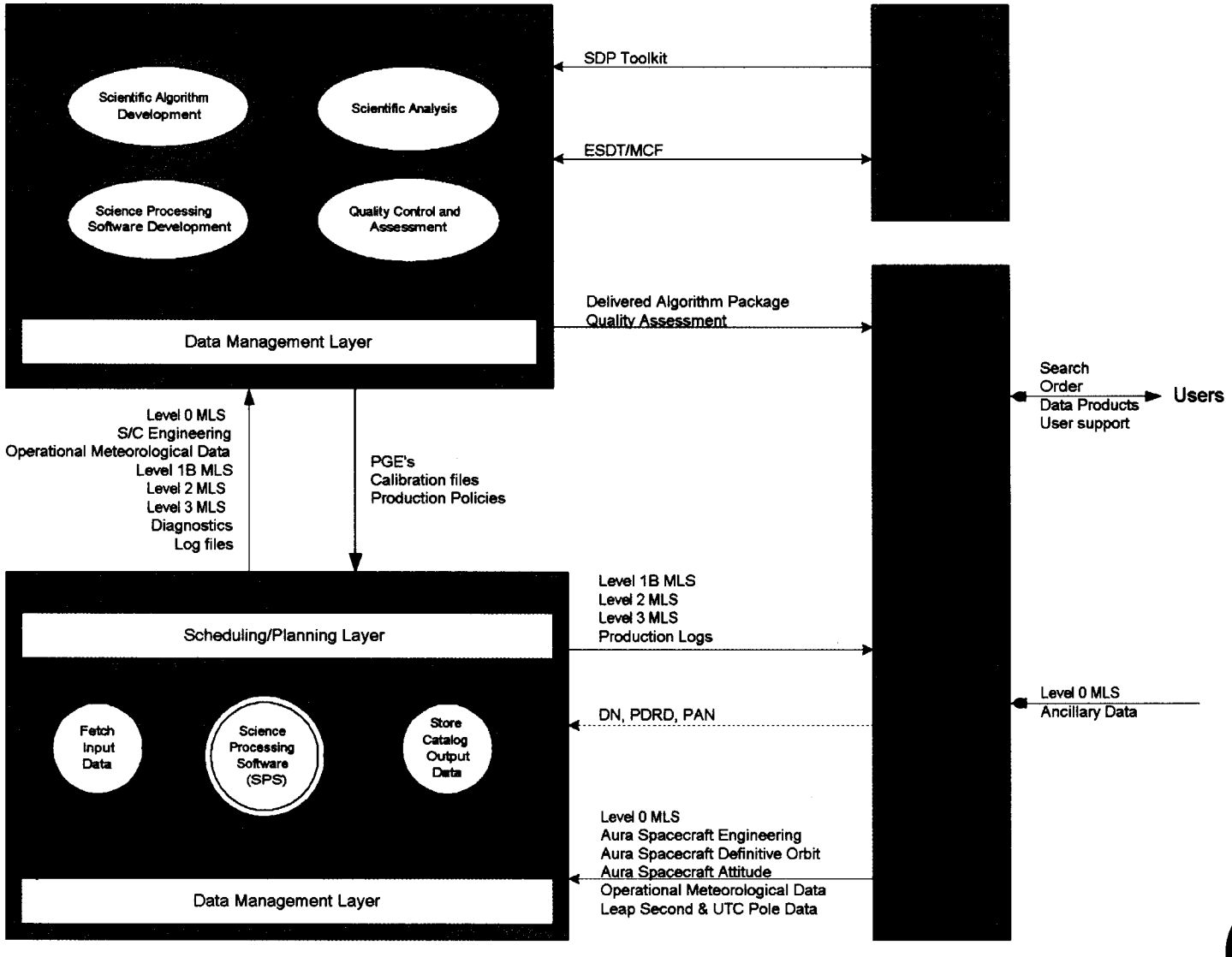
MLS Functional Block Diagram



MLS Science Data Processing

- **Level 1 Processing:**
  - **Accepts Level 0 (unprocessed instrument data) and Aura spacecraft ancillary data**
  - **Produces Level 1B products (calibrated radiances) and associated instrument engineering and diagnostic data**
- **Level 2 Processing:**
  - **Accepts Level 1B products and operational meteorological data**
  - **Produces a set of daily Level 2 products (geophysical parameters at full resolution) and diagnostic and ancillary data**
- **Level 3 Processing:**
  - **Accepts Level 2 products**
  - **Produces a set of Level 3 products**
    - » daily and monthly gridded maps
    - » daily and monthly zonal means
- **Software is developed using the Science Data Processing (SDP) Toolkit.**
  - **Capable of running in the DAAC environment.**
- **All output products are in HDF5 or EOS-HDF5**

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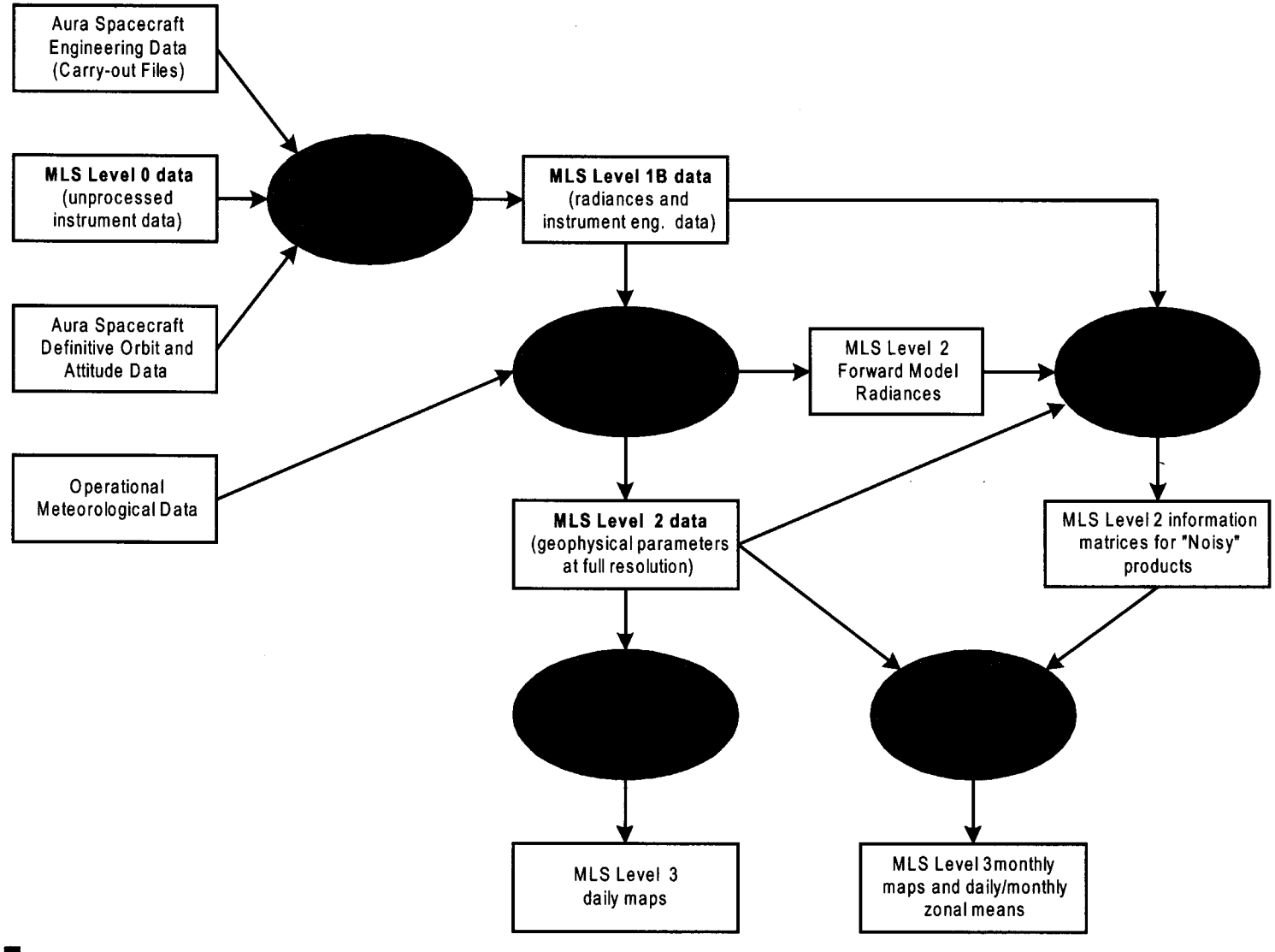
MLS Science Data Processing Flow



MLS SIPS

- Accepts all MLS Level 0 data and ancillary data as input from GES-DAAC and stores for subsequent processing.
  - GES-DAAC will push all files to MLS SIPS via ftp.
- Processes the science data for the entire mission from Level 0 to Level 1B, Level 2, and Level 3 products.
- Supports re-processing of data.
  - Stores all incoming data for the duration of the mission.
  - V2 is planned 6 months after receipt of first data.
  - V3 will be 1.5 years after V2.
  - V4 will come 2 years after V3.
- Delivers all standard data products including production history logs to the GES-DAAC for archive and distribution.
  - Using a Product Delivery Record (PDR) server.
- Delivers all data products including inputs, outputs, and diagnostics to MLS SCF.

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MLS SIPS - continued

- Requests any historical data using the Machine-to-Machine Gateway (MTMGW).
- Checks the integrity of data holdings against the GES-DAAC data holdings using MTMGW search capabilities.
- Receives MLS PGEs from the MLS Science Team/SCF.
- Receives production policies and calibration parameters from the MLS Science Team.
- Will be staffed only 8 hours/day, 5 days/week, but will be automated and operational 24x7.
- Design and implementation has heritage to ICEsat SIPS and to V0 GES-DAAC.

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Inputs from GES-DAAC to MLS SIPS

- MLS Level 0 Science Data including memory dump
- MLS Level 0 Instrument Engineering Packets
- Aura spacecraft 1 second GBAD with 8 Hz gyro
- Aura Spacecraft Carryout File
  - Eg. Temperature, survival, voltages, ...
- NCEP Operational Meteorological Data
  - NCEP GDAS/Stratospheric analysis combined product (EOS-HDF)
  - NCEP GDAS Operational Product – GDAS0ZFH (EOS-HDF)
- DAO Operational Meteorological Data
  - DAO tsyn3d_mis_p First Look – DFLAPMIS (EOS-HDF)
  - DAO tsyn2d_mis_x First Look – DFLAXMIS (EOS-HDF)
- Aura Spacecraft Definitive Ephemeris Data (HDF4)
- Aura Spacecraft Attitude Data (HDF4)
- Leap second & UTC Pole data updates
- Various E-mail for notification when exchanging data

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Outputs from MLS SIPS to GES-DAAC

- Level 1 - production is daily
  - Calibrated radiances from filter channels and digital autocorrelators
  - Orbit, attitude, and tangent point geolocation data
  - Calibrated diagnostic engineering data
- Level 2 - production is daily
  - 17 geophysical species at full resolution in swath format
  - Ancillary and diagnostic products
- Level 3 - production is monthly, even for daily products
  - Daily Maps for each of 13 species
  - Daily Zonal Means for standard and diagnostic products
  - Monthly Maps for all geophysical species
  - Monthly Zonal Means for standard and diagnostic products
- Production Log Files - for each PGE and each production run
- Delivered Algorithm Package
- Quality Assessment

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Instrument photos